CLAIMS

I claim:

1. A planar tunable capacitor comprising:

a first capacitor electrode;

a second capacitor electrode proximate the first capacitor electrode, the first and second capacitor electrodes forming a capacitor;

a gap defined by the capacitor electrodes, the gap consisting of non-conducting material;

a ferro-electric layer proximate the gap;

a bias electrode proximate the ferro-electric layer;

wherein the bias electrode is not electrically connected to either of the capacitor electrodes.

2. The tunable capacitor of claim 1, further comprising a control signal generator coupled to a variable DC voltage source, the variable DC voltage source also coupled to the bias electrode for applying a variable DC voltage to the bias electrode.

3. The tunable capacitor of claim 1, wherein the second electrode is positioned within 3.0 microns of the first electrode.

4. The tunable capacitor of claim 1, wherein the capacitor comprises a gap capacitor.

5. The tunable capacitor of claim 1, wherein the capacitor comprises an interdigital capacitor.

6. The tunable capacitor of claim 1, wherein the capacitor is formed on a substrate.

7. The tunable capacitor of claim 6, wherein the substrate comprises a material chosen from the group consisting of: sapphire, magnesium oxide, silicon dioxide, alumina, and FR4.

8. The tunable capacitor of claim 1, wherein the bias electrode comprises a material chosen from the group consisting of: gold, silver, platinum, copper, and doped silicon.

9. The tunable capacitor of claim 1, wherein a thickness of the bias electrode is less than about 0.01 microns.

10. The tunable capacitor of claim 1, wherein an electrical thickness of the bias electrode is less than a fraction of about 0.1 times a skin depth of an RF signal.

11. The tunable capacitor of claim 10, wherein the RF signal comprises a 2.0 GHz signal.

12. The tunable capacitor of claim 1, wherein the ferro-electric layer is formed on the bias electrode.

13. The tunable capacitor of claim 1, wherein a thickness of the ferro-electric layer is equal to about one micron.

14. The tunable capacitor of claim 1, wherein a field attenuation caused by the bias electrode is about 0.28 percent.

15. The tunable capacitor of claim 14, wherein the field attenuation comprises field attenuation of a RF signal having a frequency equal to about 2.0 Ghz.

16. The tunable capacitor of claim 1, wherein the ferro-electric layer comprises barium strontium titanate.

17. The tunable capacitor of claim 1, wherein the bias electrode comprises two fingers.

18. The tunable capacitor of claim 1, wherein the bias electrode comprises two fingers that are not connected inside the gap.

19. The tunable capacitor of claim 1, wherein the bias electrode comprises two fingers connected at both ends.

20. A planar tunable capacitor comprising:

a ferro-electric material;

a first capacitor electrode electro-magnetically coupled the ferro-electric material;

a second capacitor electrode electro-magnetically the ferro-electric material the first and second capacitor electrodes forming a capacitor;

a bias electrode coupled to the ferro-electric material;

wherein:

the first capacitor electrode, the second capacitor electrode and the bias electrode are adapted to change the dielectric constant of the ferro-electric material responsive to a bias voltage applied to the bias electrode and no other electrode substantially contributes to the changing of the dielectric constant; and

the first capacitor electrode, the second capacitor electrode and the ferro-

electrode material are positioned such that the dielectric constant of the ferro-electric material effects a capacitance of the capacitor.

21. The tunable capacitor of claim 20, further comprising a control signal generator coupled to a variable DC voltage source, the variable DC voltage source also coupled to the bias electrode for applying a variable DC voltage to the bias electrode.

22. The tunable capacitor of claim 20, wherein the second electrode is positioned within 3.0 microns of the first electrode.

23. The tunable capacitor of claim 23, wherein the capacitor comprises a gap capacitor.

24. The tunable capacitor of claim 20, wherein the capacitor comprises an interdigital capacitor.

25. The tunable capacitor of claim 20, wherein the capacitor is formed on a substrate.

26. The tunable capacitor of claim 25, wherein the substrate comprises a material chosen from the group consisting of: sapphire, magnesium oxide, silicon dioxide, alumina, and FR4.

27. The tunable capacitor of claim 20, wherein the bias electrode comprises a material chosen form the group consisting of: gold, silver, platinum, copper, and doped silicon.

28. The tunable capacitor of claim 20, wherein a thickness of the bias electrode is less than about 0.01 microns.

29. The tunable capacitor of claim 20, wherein an electrical thickness of the bias electrode is less than a fraction of about 0.1 times a skin depth of an RF signal.

30. The tunable capacitor of claim 29, wherein the RF signal comprises a 2.0 GHz signal.

31. The tunable capacitor of claim 20, wherein the ferro-electric material comprises a ferro-electric layer formed on the bias electrode.

32. The tunable capacitor of claim 20, wherein the ferro-electric material comprises a ferro-electric layer having a thickness of equal to about one micron.

33. The tunable capacitor of claim 20, wherein a field attenuation caused by the bias electrode is about 0.28 percent.

34. The tunable capacitor of claim 33, wherein the field attenuation comprises field attenuation of a RF signal having a frequency equal to about 2.0 Ghz.

35. The tunable capacitor of claim 20, wherein the ferro-electric material comprises barium strontium titanate.

36. The tunable capacitor of claim 20, wherein the bias electrode comprises two fingers.

37. The tunable capacitor of claim 20, wherein the bias electrode comprises two fingers that are not connected inside the gap.

38. The tunable capacitor of claim 20, wherein the bias electrode comprises two fingers connected at both ends.

39. A wireless communication device comprising:

a planar tunable capacitor comprising:

a first capacitor electrode;

a second capacitor electrode proximate the first capacitor electrode, the first and second capacitor electrodes forming a capacitor;

a gap defined by the capacitor electrodes, the gap consisting of non-conducting material;

a ferro-electric layer proximate the gap;

a bias electrode proximate the ferro-electric layer;

wherein the bias electrode is not electrically connected to either of the capacitor electrodes; and

a transceiver comprising a band pass filter, the filter coupled to the capacitor.

40. The wireless communication device of claim 39, further comprising a control signal generator coupled to a variable DC voltage source, the variable DC voltage source also coupled to the bias electrode for applying a variable DC voltage to the bias electrode.

41. The wireless communication device of claim 39, wherein the second electrode is positioned within 3.0 microns of the first electrode.

42. The wireless communication device of claim 39, wherein the capacitor comprises a gap capacitor.

43. The wireless communication device of claim 39, wherein the capacitor comprises an interdigital capacitor.

44. The wireless communication device of claim 39, wherein the capacitor is formed on a substrate.

45. The wireless communication device of claim 44, wherein the substrate comprises a material chosen from the group consisting of: sapphire, magnesium oxide, silicon dioxide, alumina, and FR4.

46. The wireless communication device of claim 39, wherein the bias electrode comprises a material chosen form the group consisting of: gold, silver, platinum, copper, and doped silicon.

47. The wireless communication device of claim 39, wherein a thickness of the bias electrode is less than about 0.01 microns.

48. The wireless communication device of claim 39, wherein an electrical thickness of the bias electrode is less than a fraction of about 0.1 times a skin depth of an RF signal.

49. The wireless communication device of claim 48, wherein the RF signal comprises a 2.0 GHz signal.

50. The wireless communication device of claim 39, wherein the ferro-electric layer is formed on the bias electrode.

51. The wireless communication device of claim 39, wherein a thickness of the ferro-electric layer is equal to about one micron.

52. The wireless communication device of claim 39, wherein a field attenuation caused by the bias electrode is about 0.28 percent.

53. The wireless communication device of claim 52, wherein the field attenuation comprises field attenuation of a RF signal having a frequency equal to about 2.0 Ghz.

54. The wireless communication device of claim 39, wherein the ferro-electric layer comprises barium strontium titanate.

55. The tunable capacitor of claim 39, wherein the bias electrode comprises two fingers.

56. The tunable capacitor of claim 39, wherein the bias electrode comprises two fingers that are not connected inside the gap.

57. The tunable capacitor of claim 39, wherein the bias electrode comprises two fingers connected at both ends.